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pasword 12345678

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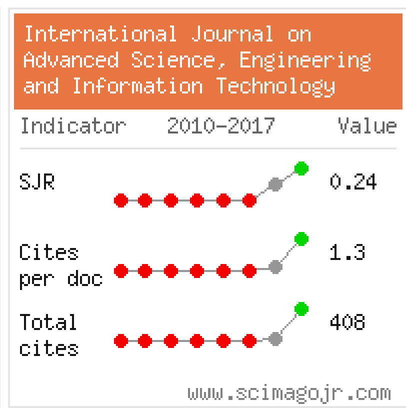
Editor in Chief
International Journal on Advanced Science, Engineering and Information Technology (IJASEIT)
ISSN: 2088-5334 / e-ISSN: 2460-6952 / DOI: 10.18517

2017 SCImago Journal Rank (SJR): 0.242
2018 SCImago Journal Rank (SJR): 0.230



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International Journal on Advanced Science, Engineering and Information Technology

#8272 Summary

SUMMARY REVIEW EDITING

Submission

Authors	Supandi Supandi, Zufialdi Zakaria, Emi Sukiyah, Adjat Sudradjat
Title	New Constants of Fracture Angle on Quartz Sandstone of Warukin Formation
Original file	8272-17225-2-SM.DOC 2019-03-10
Supp. files	8272-17313-1-SP.PDF 2019-03-14 ADD A SUPPLEMENTARY FILE
Submitter	Supandi Supandi
Date submitted	March 14, 2019 - 06:27 AM
Section	Articles
Editor	Rahmat Hidayat
Author comments	

Dear Chief Editor of **International Journal on Advanced Science, Engineering and Information Technology (IJASEIT)**

We are sending you our manuscript for possible publication in **International Journal on Advanced Science, Engineering and Information Technology (IJASEIT)** entitled:

New Constants of Fracture Angle on Quartz Sandstone of Warukin Formation

The manuscript has not been published, is not currently submitted for publication elsewhere and all the authors have seen and approved the manuscript.

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Status

Status	In Editing
Initiated	2020-06-14
Last modified	2020-06-14

Submission Metadata

EDIT METADATA

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Title and Abstract

Title New Constants of Fracture Angle on Quartz Sandstone of Warukin Formation

Abstract This research aims to determine constants which calculating the fracture angle based on the Mohr-Coulomb concept for quartz sandstone. The fracture angle based on the results of calculations using mathematical formulas and measurement results in the laboratory are compared. The empirical result for analysis is obtained from direct measurement under uniaxial test with a single fracture and compared them based on mathematic calculation. Determination of the friction angle was performed using undrained-unconsolidated triaxial method. Determination of the correlation constants was conducted by plotting the scatter graph between the friction angle and fracture angle. The constants based on the laboratory test is higher than that of the Mohr-Coulomb concept. The increasing constants depends on several factors: mineralogy, cohesion, internal friction angle, density, void ratio and passion ratio. The constants of the fracture angle for the quartz sandstone should be changed from 45 to 53.705

Indexing

Keywords friction angle; fracture angle; Mohr-Coulomb; uniaxial test; sandstone of Warukin Formation.
Language en

Supporting Agencies

Agencies —

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Please submit your revision in 10 days. More than 10 days of paper will be rejected from the system. Re-upload your revision into journal system NOT via email.

Editor

Reviewer A:

Dear Authors,

Thank you for submitting your valuable research findings. However, we still need you to improve the quality of the manuscript according to the reviewer's comments :

Before continuing to the further step, please arrange the manuscript well, some pages are still blank.

Abstracts 220-250 words, consists of the problem identification, teh objectives. clear methodology, result and short discussion.

Looking forward to the revision. Good luck!

Kind regards

Reviewer B:

1. I have suggestion that the title focusing on quartz sandstone and saying Warukin Formation can be ignored since number of sample just limited. Detailing sandstone characteristic can be described into this research.

2. Please double check with your organization.

3. Warukin Formation can be ignored from Keyword

4. Reference related provenance sandstone of Warukin formation is required to reach description sandstone typical to be discussed. You can explore from reputable journal from last three years.

5. Good photograph, additional photograph from thin section may be is required to improvement detailing sandstone characterization (If possible).

6. Please detailing ASTM number for labratory test since ASTM is consist many number.

7. Double identity from picture Figure 3 b...please delete unnecessary information.

8. Absolutely, this research is important to help man engineer to make further analysis since existing method still generate for any material/rock. Rock is have heterogeneous type so generate one formula to any rock is impossible. This research is clear describing correction number for specific quartz sandstone. I think this result very important for geotechnical engineer make detail analysis. This formula is applicable in the field and trial is possible since some mining operation is existing on Warukin formation.

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New Constants of Fracture Angle on Quartz Sandstone

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Abstract*— Calculation of fracture angle based on the Mohr-Coulomb concept has been generalized to all lithologies, whereas each lithology has heterogenous characteristic that is not the same as one another. This research aims to determine constants which calculating the fracture angle based on the Mohr-Coulomb concept for quartz sandstone. The fracture angle based on the results of calculations using mathematical formulas and measurement results in the laboratory are compared. The empirical result for analysis was obtained from direct measurement under uniaxial test with a single fracture and compared them based on mathematical calculation. Laboratory testing was applied to 50 mm-sized core samples of sandstone. The value of fracture angle was obtained after taking uniaxial testing by measuring fracture angle against the plane directly. Determination of the friction angle was performed using undrained-unconsolidated triaxial method. Determination of the correlation constants was conducted by plotting the scatter graph between the friction angle and fracture angle. The correlation shows that fracture angle has a very strong relationship with rock characteristic. The constants based on the laboratory test are higher than that of the Mohr-Coulomb concept. The increasing constants depend on several factors: mineralogy, cohesion, internal friction angle, density, void ratio and Poisson's ratio. The constants of the fracture angle for the quartz sandstone should be changed from 45 to 53.705. This result may be a proof that generalizing the formula of fracture angle to all lithologhies may not be applied due to the differences of their characteristics in defining the fracture angle.

***Keywords*— friction angle; fracture angle; Mohr-Coulomb; uniaxial test; quartz sandstone.**

I. Introduction

Rock engineering properties are considered to be the most important parameters of the mechanical properties of rock, and failure criterion are mainly obtained from laboratory triaxial testing. The most widely used failure criterion is the Mohr-Coulomb criterion. To obtain the Mohr-Coulomb failure envelope, a conventional triaxial test is used. Conventional triaxial testing is simple but requires multiple samples. Aside from limited availability, multiple samples also provide potential uncertainty in the resulting parameters due to sample heterogeneity, as different samples might have significant variations in strength.

[1] carried out an analysis of the deformation characteristics of bedded sandstone. They determined the deformation of sandstone by using an optical deformation and strain measuring system during uniaxial testing. Increasing stress occurred at the bedding contact, but the fracture angle has not been determined yet. Determination of the fracture angle of massive sandstone has not been tested yet. Peak strength of porous sandstone is depending porosity, pore angle, young modulus and pore ratio [2].

Deformation under uniaxial and Triaxial depends on some factor such as isotropic material, mineralogy, strain, passion ratio and fissure [3]. On the homogenous sandstone strains up to 0.2%, but this number will increase as long as the clay content increases. Determination of sandstone material based on size distribution and mineralogy is ignored Failure model of the specimen depends on type of rock, mineralogy of rock and stress condition [4]. Existing fissure and lamination also contribute toward failure mode. Comparison between hyperbolic failure and establish failure criteria for cohesive – frictional material. The study is carried out through different lithology and one cement but not detailing to measure fracture angle [5]. Calibrate of fracture angle is required for each material since it has heterogeneous characteristic, so engineering design will be resulting realistic result refers to each lithology. Sliding body of slide plane is dependent on some contribution factors, one of them is crack shape. Crack shape involves position, angle of cracking and shape roughness. Increasing angle of rock crack depends on crack shape on reliability index [6]. The failure criterion is formulated by comparing the available energy release rate due to the presence of crack in the matrix and fracture toughness in the interface. The parameter of the failure criterion is dependent on material properties, ply thickness and laminate compliance properties before and after presence of a matrix crack [7].

Calculation of the fracture angle has not been measured yet. Peak strength and crack damage of sandstone is depending confining pressure and it's better can be described by non-linier Hoek-Brown Criterion than by linier Mohr Coulomb Criterion [8]. Cohesion and internal friction angle are decreased with the increasing exposure time [9], [10]. Decreasing cohesion significantly is occurred after 100days after exposing and it will be decreasing as long as exposure time. According to the classification by Dickinson and Suczek, provenance of Warukin standstones is generally recycled orogen with subclassification of quartzose recycled [11].

The maximum fracture angle failure criterion for shale about 60° [12]. The number can't have generated to other material since some other material showing lower number such as gneiss is showing fracture angle about 45°. The number of fracture angle is depend on deformability of rock, modulus, strength, permeability and orientation of plane ([13], [14]). Modified failure criterion shall be conducted on the isotropic rock for different plane bedding share. Correction number shall be applied while testing conducted on different bedding share [15]. Comparison failure criterion is carried out toward fifteen failure criterion and resulting not better failure criterion for any materials. Each lithology having unique failure criterion and development failure criterion for each lithology is able to apply [16].

New failure criterion has been studied by many researchers i.e. [17], [18], [19], [20], [21], [22], [23], [24], [25]. The fracture angle is depend on degree of saturation, changing strain and water saturation and it's occurred special at the soft rock [26]. The overall stress-strain behaviors of rocks are then obtained using the crack damage volume fraction. The theoretical results are found to be in a good agreement with experimental data [27]. Density is having contribution toward the changing fracture angle on concrete [28].

Micromechanical grain of the hard rock should consider:

1. Grain size distribution
2. Mineralogy of rock
3. Plasticity
4. Creeping or strain
5. Crack growing
6. Intra granular fracturing
7. Shear and tensile cracking
8. Macroscopic wing rock
9. Primary and secondary creeping

Study related microstructure also done by [29] and [30]. Mineralogy is the main factor toward behavior of granite and it will be affected toward strength, elastic and microstructure [31]. Confining pressure and hole diameter will be affected toward Poisson's ratio and peak strain of hollow sandstone [32]. Stress–strain of soft rock with porous material is having correlation with micromechanics based on the thermodynamics damage model [27]

Pore geometry effects have important implications for rock strength in general, in addition to the maintenance of open pore space, which in turn contributes to the long-term maintenance of permeability in the subsurface [33]. Friction angle will be decompose into critical stage friction angle and a portion of the dilatacy angle to capture the peak phenomenon of dilative sand and resulting better performance than conventional Mohr Coulomb Model [24].

The uniaxial strength of rock with one set of joints is related to the inclination and number of joints. As the number of joints increases, the rock strength gradually decreases and becomes approximately constant. The fracture angle has not been determined yet. Loading condition under uniaxial test is having significant impact toward crack pattern and shear crack [34]. Three types of characteristic stresses present an increasing the flaw angle. Increasing flaw angle will be responded by increasing stress [35].

Opening rock under uniaxial test is having significant effect on the rock mechanical behavior. Decreasing rock strength will be followed by decreasing young modulus [36]. Increasing the elasticity modulus and Poisson's ratio will be followed by increasing confining pressure. The relationships between the friction angle and the cohesion, strength and bedding plane angle are the same as that with the elasticity modulus.

Strength reduction factor is decreasing as long as the increasing of joint orientation angle (degree) and it's important to pay attention to determination fracture angle of rock slide [37].

The angle of internal friction intended to measure of the ability of a unit of rock or soil to withstand a shear stress. It is the angle (φ), measured between the normal force (N) and resultant force (R), that is attained when failure just occurs in response to a shearing stress (S). Its tangent (S/N) is the coefficient of sliding friction. Its value is determined experimentally. Geopolymerization is giving significant impact toward the increasing shear strength under Unconfined Compression strength test for stabilized fine-grained soil [38]. Surface roughness gives significant effect toward shear strength and failure criterion of claystone. Rough surface is resulting higher cohesion and friction angle compares to smooth surface [39].

Fracture angle in nature has an important effect on rock behavior. The fracture angle of anisotropic rock is related to the bedding plane. The failure pattern of uniaxial compression is generally tensile failure or tensile failure followed by shear failure. The fracture angle decreases with the increase in confining pressure [40].

II. THE MATERIAL AND METHOD

New constants predict the fracture angle of quartz sandstone based on numerical method proposed by Mohr Coulomb. Existing parameter to calculate fracture angle based on Mohr Coulomb method using 45° without mention on specific rock. The numerical method based on Mohr Coulomb methods are not applicable for all materials because each material has special fracture angle characteristics that depend on several factors. Quartz sandstone is also having special characteristic related fracture angle under laboratory test.

The sandstone materials used in this study were collected from the Kusan Block at Tanah Bumbu, South Kalimantan, Indonesia. The samples were collected from a part of the mine slope approximately 50 cm length; undisturbed samples were collected with 70 mm diameters. The samples were wrapped using plastic to maintain their basic properties. The rock samples used in this study were 40 samples of sandstone with medium-fine grain sizes. Sample preparation was conducted by conforming to the ASTM (American Society for Testing and Materials)-specified ASTM standards D4220-95.

The samples were grouped based on visual descriptions carried out to determine the homogeneity of the samples using laboratory testing. The focus of this study was on the behavior of quartz sandstones in the Warukin formation located in the Kusan Blok. XRD analysis was required to determine the mineral content of the rock. Based on the XRD analysis, quartz is the predominant rock component, and the quartz content exceeds 90% (Fig. 1). Several analyses of the sandstone resulted in a similar composition, and it is likely that the sandstone mineralogy is homogenous, so the assessment of the mechanical properties will be the next focus. The mineral composition of the sandstone is shown in Fig. 2.

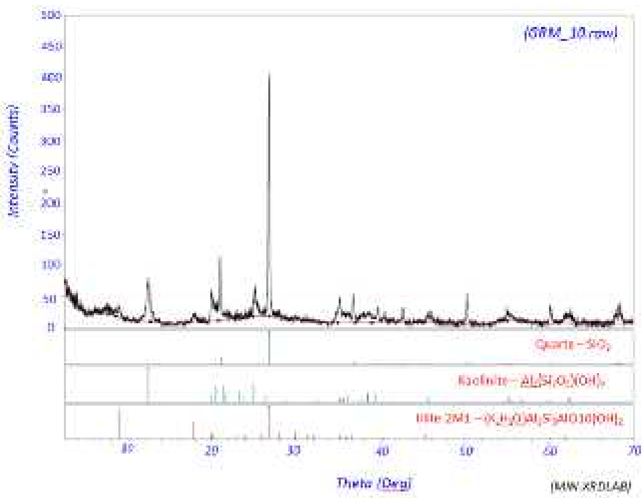

Fig. 1 XRD Spectrograph, it appears that quartz minerals dominate sandstones.

The rupture angle and shear angle were assessed using triaxial testing. The results from the triaxial tests were used to obtain the cohesion and friction angle. Triaxial compression shear tests (UU) were performed when the samples were unconsolidated and undrained to determine the friction angle (phi) and cohesion (c) under maximum stress conditions and this method is effective because it is approximately the field conditions. The research was conducted by laboratory analysis with an empirical triaxial compression test method, referring to ASTM D.2850-87.

Fig. 2 Quartz grains overview under microscope

The fracture angle of the rock was obtained using uniaxial compression testing, referring to ASTM D4405-93 on uniaxial compression testing of the elastic modulus for rock core specimens. The test used devices with an axial loading range of 0-4 600 kN (compression) and axial displacement range of 0-100 mm (±50 mm). The sensor accuracy in each test was approximately 0.5%, and the traversal deformation was approximately -2.5-12.5 mm.

Uniaxial testing will obtain the fracture angle at peak strength. Determination of the type of fracture angle has been described by [41]. The fracture angle can divided into four types:

1. Single fracture
2. Parallel fractures
3. Intersecting fractures
4. Mixed fractures

This research was focused on measuring the fracture angle of a single fracture type. The fracture angle magnitude was obtained by manually measuring the crack zone from horizontal for all the samples tested. Figure 3 shows the examples of measurement result. Measurements were collected from all existing sandstone samples in order to perform an empirical analysis.

Based on the achievements of earlier researchers, this paper will continue to investigate the constants controlling the fracture angle under uniaxial testing. This study proposes to ensure that the constants used to calculate the fracture angle from the Mohr-Coulomb concept is not applicable on any materials. Each material is suggested to have a specific constants to determine its fracture angle. Additionally, this research investigates factors that will affect this constants. The experimental results will provide a reference for engineering practice, especially for slope stability.

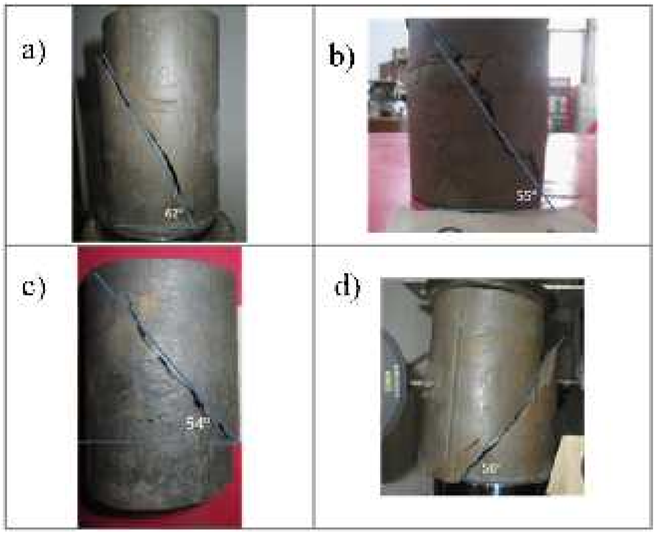

Fig. 3 Measurement fracture angle on quartz sandstone after uniaxial test resulting different fracture angle. (a) fracture angle 62°, (b) fracture angle 55°, (c) fracture angle 54° and (d) fracture angle about 56°.

III. Results and Discussion

Mineralogical testing obtained a quartz composition above 90%; therefore, the mineralogy of the sandstone is homogeneous. A statistical test was conducted to ensure that the tests were conducted on the same rock group. A test was carried out on the quartz mineral composition. The first statistic test was a rock normality test.

The normality and homogeneity test was carried out determination characteristic of quartz sandstone based on mineral composition. This test is important to make sure that the analysis is carried out on the similar mineralogy and sample having similar characteristic. Normality test is resulting that quartz sandstone having normal distribution based on quartz content. The homogeneity test is also resulting quartz sandstone from Kusan block is homogen or uniform.

Based on the statistical tests showing the same characteristics, the fracture angle magnitude is controlled by the physically rock characteristics. To determine the constants that affects the fracture angle, plotting of all the constants tested was performed. A strong correlation degree is considered to indicate a factor affecting the difference between the mathematical and empirical values.

In the Mohr-Coulomb concept, the greatest stress is σ_1, while σ_3 is the smallest stress. When $\sigma_1$is applied to a sample and is greater than the strength of the rock, a fault will form. Mathematically, Mohr-Coulomb considers that the fracture angle will form at a 45° angle from half of the friction angle. However, this value is highly dependent on the rock properties, so that in this study, it will be empirically assessed whether sandstone has a fracture angle that follows the Mohr-Coulomb theory or other equation.

The Mohr-Coulomb concept illustrated in Fig. 4 explains that ø is the fracture angle obtained from horizontal. The fracture angle is a function of the combination of rock strength and main source emphasis. Cohesion is determined by the line that intersects the shear strength along the Y axis.

Based on this study, the friction angle is correlated with the cohesion, hardness and another physical rock characteristic.

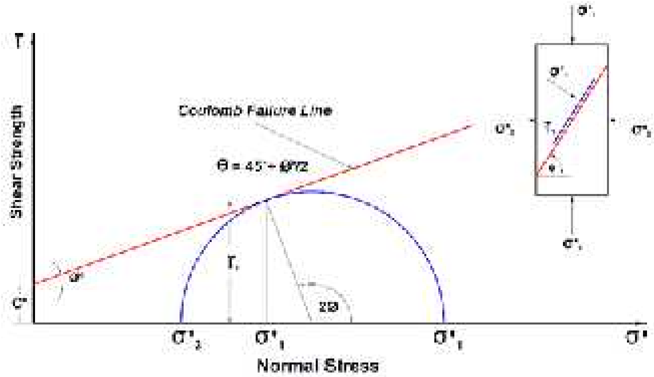

Fig. 4 Mohr-Coulomb concept of failure angle [42]

In the first stage, the fracture angle is calculated based on the friction angle using the Mohr-Coulomb formula. The fracture angle is determined by:

$$Fracture\ \ Angle = 45° + ø/2 \tag{1}$$

Plotting in a scatter diagram results the following equation:

$$y = 0.5\ x + 45 \tag{2}$$

The second analysis was conducted by plotting the friction based on undrained-unconsolidated triaxial testing with the fracture angle based on uniaxial testing. Measurement of the fracture angle was conducted manually based on the fracture shape after the uniaxial tests. Measurements were conducted on the 38 samples tested. The measurement results provide the fracture angle for each friction angle (Fig. 5).

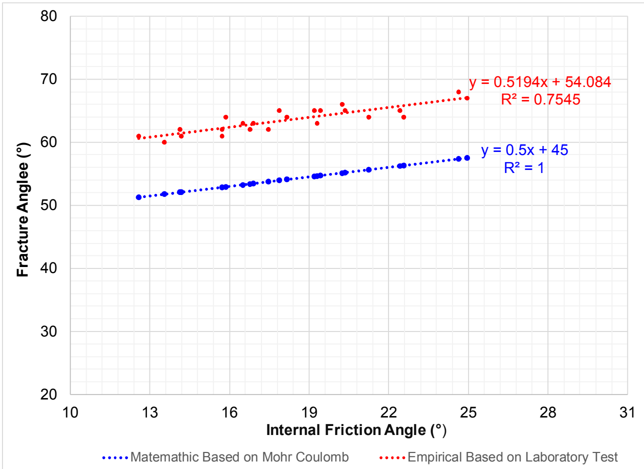

Fig. 5 Comparison of the fracture angle between the Mohr-Coulomb concept and empirical analysis based on laboratory test

The degree of correlation was approximately 0.75 and categorized as a strong correlation. The equation based on the correlation is:

$$y = 0.5215x + 53.705 \tag{3}$$

These two correlations generate parallel lines and the same type of relationship. The difference between the equations is constant. The fracture angle based on the Mohr-Coulomb concept is approximately 45°, while the result of the fracture angle based on the laboratory data is approximately 53.705°.

Furthermore, the influence of several factors with possible constant changes in value was analysed, and some limitations of the constants were generated from the empirical measurements. The analysis was performed by a correlation between the fracture angle and several mechanical and physical characteristics. The correlation analysis was performed by plotting the fracture angle with several factors.

The first analysis was plotting the fracture angle with the rock strength. The plotting result is shown in Fig. 6. The results from this test were plotted in a diagram to determine the correlation between the fracture angle and rock strength. The degree of correlation was 0.8411 (very strong correlation) with the regression correlation fracture angle and strength expressed;

$$y = 5E - 23x^{13.7748} \quad (4)$$

Fig. 6 shows that the fracture angle increased significantly with strengths between 30 and 50 kPa and that this trend decreased with strengths up to 50 kPa.

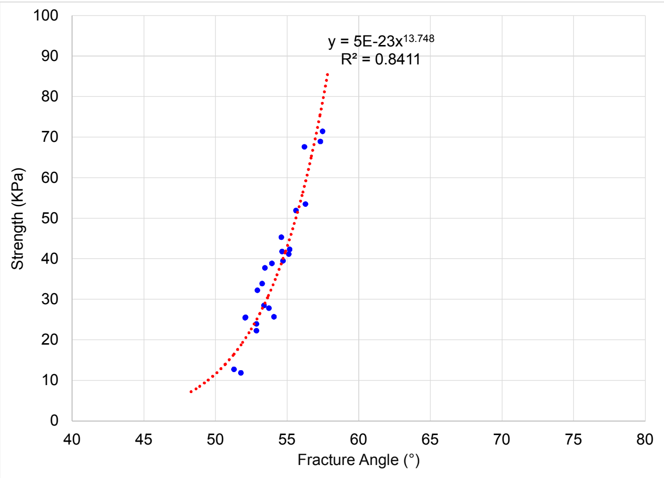

Fig. 6 Relationship of fracture angle with strength

The other analysis was the correlation with cohesion. The plotting result is shown in Fig. 7. The degree of correlation was 0.6702 (strong correlation).

It is show that the trend is similar to that with strength; the cohesion increased from 50 to 250 kPa, and the degree of correlation is strong. Based on this study, the cohesion has a role in changing the fracture angle.

The fracture angle is correlated to the physical rock characteristics and the contribution of each factor is obtained. The first basic property correlated with the fracture angle is the moisture content. The moisture content is plotting on the vertical axis, as shown in Fig. 8. It is shown that the moisture content plays a considerable role in changing the fracture angle by a constant value. The correlation value between these two parameters was 0.777, meaning that there is a strong correlation. When the moisture content decreases, the fracture angle increases. Decreasing moisture content simultaneously increases the rock strength; therefore, it is concluded that the moisture content has a strong influence on the fracture angle. The correlation fracture angle with moisture content expressed:

$$y = 291753x^{-2.379} \quad (5)$$

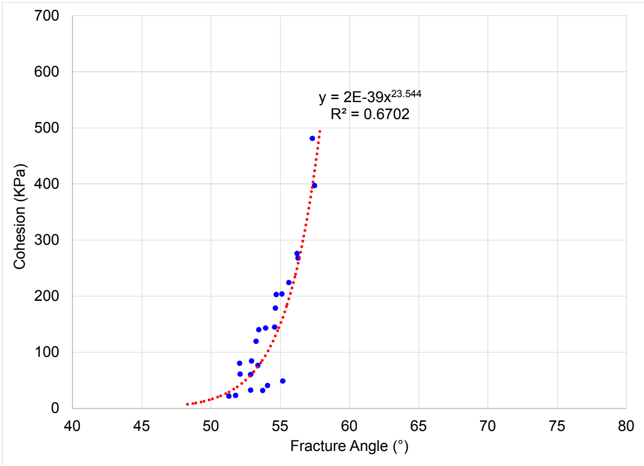

Fig. 7 Relationship of fracture angle with cohesion

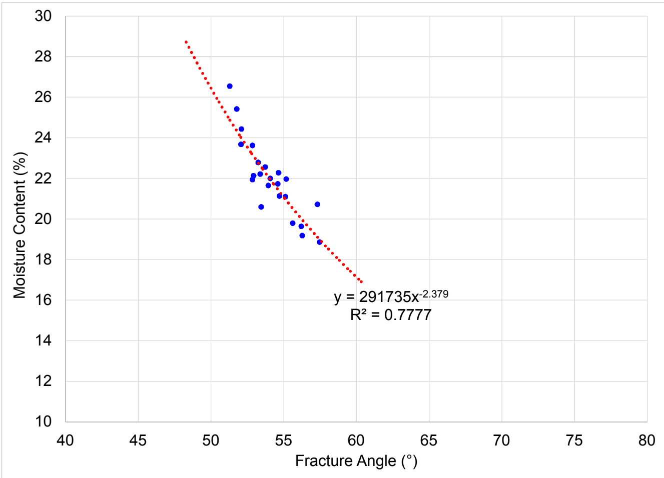

Fig. 8 Relationship of fracture angle with moisture content

A correlation is also conducted for the fracture angle and void ratio, and the graph below shows a degree of correlation of 0.6813, which indicates a strong correlation. It was observed that when the void ratio decreases, the fracture angle increases (Fig. 9). The correlation equation is as follows:

$$\text{Void Ratio} = 9060x^{2.411} \quad (6)$$

Another factor is Poisson's ratio, which is the ratio of the fracture angle axial strain and diametric strain. This value needs to be analyzed because it theoretically has a strong correlation to the stress distribution. When rocks are forced before fracturing, they will respond to the strain change. Based on this condition, it is important to know the fracture angle correlation between Poisson's ratio and the fracture angle.

The result of the correlation is show in Fig. 10, where the correlation between the fracture angle and Poisson's ratio denotes a moderate relationship with a degree of correlation of 0.4385. The greater the value of Poisson's ratio is, the greater the generated fracture angle will be. From the correlation output the correlation formula is obtained.

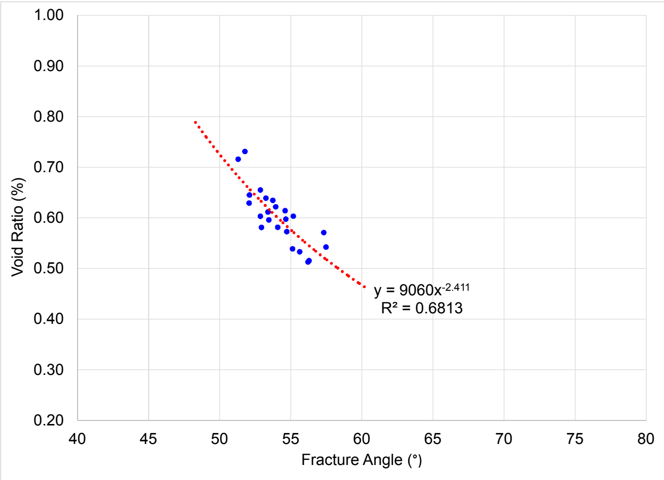

Fig. 9 Relationship of fracture angle with void ratio

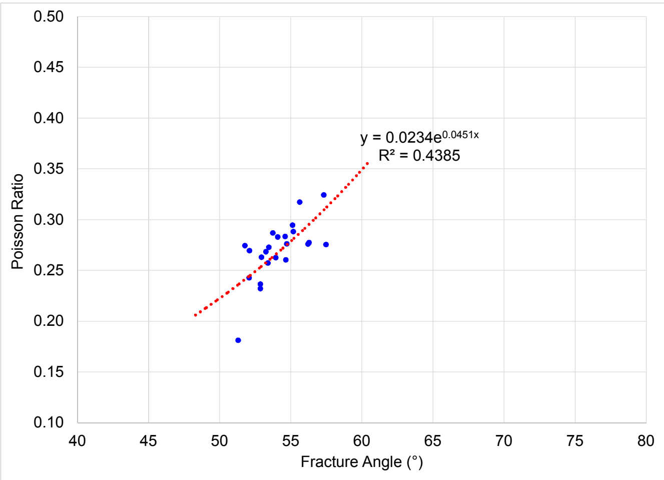

Fig. 10 Correlation of fracture angle with Poisson's ratio

Other physical inputs into this analysis are the wet and dry density. The fracture angle is predicted to be associated with the rock mass density; therefore, the correlation between the fracture angle and density needs to be understood (Fig. 11). Increasing wet and dry density will be followed by increasing fracture angle with function is relative linier. Fracture angle about 53-58° is occurred at the wet density around 1.8 – 2.2 gr/cm^3. Wet density and dry density is having strong relation with moisture content and refer with Fig. 8 that moisture content having strong relation with fracture angle, so density have strong relation with fracture angle is reasonable.

The degrees of correlation for the wet and dry densities were 0.1294 and 0.2805, respectively. From this degree of correlation, a poor relationship between fracture angle and rock density was obtained. The correlation equations for the wet and dry densities are:

$$\text{Wet Density} = 0.2145x^{0.5655} \quad (7)$$

$$\text{Dry Density} = 0.233x^{1406} \quad (8)$$

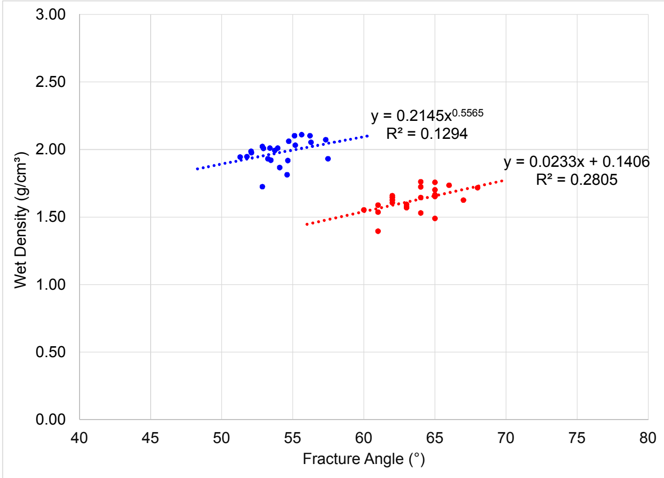

Fig. 11 Correlation of fracture angle with wet/dry density

The fracture angle of the quartz sandstone did not depend on the axial strain since the degree of correlation is very small (0.0007). Fig. 12 shows the distribution of axial strain, which does not seem to have a good relationship with the fracture angle. Rock strain didn't have correlation with axial strain but fracture angle having good relation with mechanical properties such as cohesion, internal friction angle and strength.

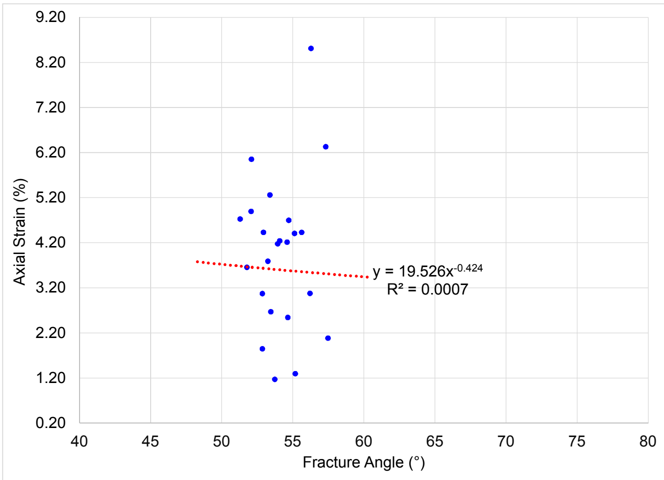

Fig. 12 Relationship of fracture angle with axial strain

IV. Conclusions

The fracture angle of sandstone is greater than that calculated with the Mohr-Coulomb equation y = 0.5x + 45 with $r^2 = 1$. However, the research test results of 38 samples of sandstone from the Warukin formation showed that the fracture angle is described by y = 0.5215x + 53.705 with r^2 = 0.75.

The test result of the constants (53.705) is greater than the calculated Mohr-Coulomb constants (45). The differences are affected by the following factors:

1. Strength
2. Cohesion
3. Void Ratio
4. Poisson's ratio
5. Density

ACKNOWLEDGMENT

Our thanks also go to the Rector of Universitas Padjadjaran who has supported the process of this publication through the 2017-2018 RKDU grants.

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Response by Authors to Reviewer's Remarks/Comments

New Constants of Fracture Angle on Quartz Sandstone

Authors: Supandi, Zufialdi Zakaria, Emi Sukiyah, Adjat Sudrajat

I am very grateful for your taking time to review this paper and provide your valuable opinions. Here, I have answered your questions and have explained the modifications that I have made to this paper. A revised manuscript is submitted addressing all the comments to the IJASEIT possible publication. The authors have summarized their replies to the Reviewers' comments in this response letter in a two columns format.. Point-by-point responses to the reviewers' comments are listed below in this letter. If there are still inappropriate parts, please point out them and I will correct them.

No	*Reviewer_A's Comments*	*Authors Response*
1	Before continuing to the further step, please arrange the manuscript well, some pages are still blank.	Thank you very much for your careful review and valuable guidance. Manuscript improvement has been carried out and obviously the paper is better compared with previous format.
2	Abstracts 220-250 words, consists of the problem identification, teh objectives. clear methodology, result and short discussion.	Thank the reviewer's kind comment. Abstract has been updated with detailing on background, objective, method, result, discussion and summary. A total word is also increasing from 143 to 248.
No	***Reviewer_B's Comments***	***Authors Response***
1	Tittle Correction with ignore "Warukin Formation"	Thank the reviewer's kind comment. Tittle has been revised with delete Wurukin Formation.---Accepted.
2	Please make sure institution name	Thank the reviewer's kind comment. The institution name has been switched from Padjadjaran University Bandung to Institute Technologi Nasional Yogyakarta after author completing his study. .---Accepted.
3	Delete Warukin formation on Keyword	Thank the reviewer's kind comment. Warukin formation has been deleted from keyword .---Accepted.
4	Additional reference for sandstone characterization of Warukin formation is required to improve quality of the paper.	Thank you very much for your careful review and valuable guidance. Reference related sandstone characteristic and characteristic lithology on Warukin Formation has been added; Both publications had been published on Scopus Journal on 2019 and 2020 respectively. [1] Supandi, Zakaria Z., Sukiyah E. and Sudradjat A., The Influence of Kaolinite-Illite Toward Mechanical Properties of Claystone, *Open Geosciences,* Vo.11, Issue 1, 2019, pp.440-446. [2] Supandi, H.G. Hartono., Geomechanic Properties and Provenance Analysis of Quartz Sandstone From The Warukin Formation, Int*ernational Journal of GEOMATE*, Vol.18, Issue 66, 2020, pp. 140-149. .---Accepted.
5	Good photograph, additional photograph from thin section may be is required to improvement	Thank the reviewer's kind comment. Improve quality image of the paper has been carried out but additional thin section didn't carried out due to restrictive petrography analysis.

	detailing sandstone characterization (If possible).	Provenance analysis and sandstone characteristic has been taken from reference. .---Accepted.
6	Please detailing ASTM number sampling handling before laboratory test is recommended since ASTM is consist many numbers.	Thank the reviewer's kind comment. References have been updated. ASTM D4220-95 (2000) related Standard Practices for Preserving and Transporting Soil Samples. .---Accepted.
7	Double identity from picture Figure 3 b. please delete unnecessary information.	Thank the reviewer's kind comment. In Figure 3 (b), double number has been deleted. .---Accepted.
8	Absolutely, this research is important to help many engineers to make further analysis since existing method still generate for any material/rock. Rock is having heterogeneous type so generate one formula to any rock is impossible. This research is clear describing correction number for specific quartz sandstone. I think this result very important for geotechnical engineer make detail analysis. This formula is applicable in the field and trial is possible since some mining operation is existing on Warukin formation.	Thank the reviewer's kind comment.

The authors appreciate the valuable comments from the Reviewers

Editor/Author Correspondence

Editor 2020-05-01 08:50 AM

Subject: [IJASEIT] Revision Required DELETE

Supandi Supandi:

We have reached a decision regarding your submission to International Journal on Advanced Science, Engineering and Information Technology, "New Constants of Fracture Angle on Quartz Sandstone of Warukin Formation".

Our decision is to: Revision Required

Please submit your revision in 10 days. More than 10 days of paper will be rejected from the system. Re-upload your revision into journal system NOT via email.

Editor

Reviewer A:

Dear Authors,

Thank you for submitting your valuable research findings. However, we still need you to improve the quality of the manuscript according to the reviewer's comments :

Before continuing to the further step, please arrange the manuscript well, some pages are still blank.

Abstracts 220-250 words, consists of the problem identification, teh objectives. clear methodology, result and short discussion.

Looking forward to the revision. Good luck!

Kind regards

Reviewer B:

1. I have suggestion that the title focusing on quartz sandstone and saying Warukin Formation can be ignored since number of sample just limited. Detailing sandstone characteristic can be described into this research.

2. Please double check with your organization.

3. Warukin Formation can be ignored from Keyword

4. Reference related provenance sandstone of Warukin formation is required to reach description sandstone typical to be discussed. You can explore from reputable journal from last three years.

5. Good photograph, additional photograph from thin section may be is required to improvement detailing sandstone characterization (If possible).

6. Please detailing ASTM number for labratory test since ASTM is consist many number.

7. Double identity from picture Figure 3 b...please delete unnecessary information.

8. Absolutely, this research is important to help man engineer to make further analysis since existing method still generate for any material/rock. Rock is have heterogeneous type so generate one formula to any rock is impossible. This research is clear describing correction number for specific quartz sandstone. I think this result very important for geotechnical engineer make detail analysis. This formula is applicable in the field and trial is possible since some mining operation is existing on Warukin formation.

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